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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Film Sealing and Cutting Apparatus and method

We, WELDOTRON CORPORATION, a corporation organized and existing under the laws of the State of New Jersey, United States of America, of 907 Frelinghuysen Avenue, Newark 14, State of New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for cutting and heat sealing superposed plies of thermoplastic films for various purposes, for example for packaging or wrapping, or for forming bags or other containers or articles, by heating sealing and cutting superimposed thermoplastic films.

According to the present invention a method for cutting and sealing an assembly of superposed plies of thermoplastic film along a predetermined line comprises releasably clamping the plies together along both sides of a zone including the line by means of a first movable pair of elongate laterally spaced clamping members and a second pair of elongate laterally spaced clamping members co-operating therewith so as to leave exposed both faces of the assembly within the zone, and heating the assembly within the zone by means of a heat source disposed out of contact with the assembly and between the first pair of clamping members to melt a gap therein along the said line and to fuse together the superposed edges of the plies bounding the gap.

The invention also provides apparatus for use in the method, the apparatus comprising a first pair of elongate laterally spaced clamping members and a second pair of elongate laterally spaced clamping members, the first pair being movable to releasably clamp such an assembly against the second pair along both sides of a zone including the said line so as

[1.]

to leave exposed both faces of the clamped assembly within the zone, and a first heating member being mounted between the first pair of clamping members for movement to a position adjacent to the clamped assembly for cutting and sealing the assembly by melting a gap along the said line and fusing together the superposed edges of the plies bounding the gap.

The method and apparatus of the present invention are applicable to thermoplastic films in general, but are especially useful for cutting and heat-sealing thermoplastic films which are wrinkled or folded or which for other reasons are difficult to seal by conventional techniques.

The superimposed films are preferably heated directly by radiant heating elements disposed at opposite sides of the clamped assembly, and it is also preferred to press the sealed beaded edges of the cut and sealed film whilst they are still plastic.

The film clamping members may be adjustable laterally of the heating member or members and provision may be made for cooling the film pressing members and the sealed edge or edges of the films.

Presently preferred embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Fig. 1 is a vertical sectional view of a heat sealing apparatus embodying the present invention, showing the superimposed films in position preliminary to the operation of the apparatus;

Fig. 2 is a vertical sectional view of part of the apparatus shown by Fig. 1, illustrating the operation of the apparatus for heating, sealing and cutting the superimposed films;

Fig. 3 is a side view of one of the heating elements and its support;

Fig. 4 is a view generally similar to Fig.

1 showing another form of the invention;
Fig. 5 is a sectional view on the line 5—5
of Fig. 4;

Fig. 6 is a sectional view on the line 6—6
of Fig. 5;

Fig. 7 is a view of part of the apparatus
shown by Fig. 4 in the condition wherein the
superimposed plies are sealed and severed, and
showing the sealed beaded edges;

Fig. 8 is a view similar to Fig. 7 showing
the condition of the apparatus when the addi-
tional pressing members are operated to press
or squeeze the sealed beaded edges;

Figs. 9, 10, 11 and 12 are views illustrating
various cross sectional forms of the radiant
heating member;

Fig. 13 is a view in elevation of part of
heat sealing and cutting apparatus wherein
provision is made for varying the distance of
the companion film pressing members from the
radiant heating member; and

FIG. 14 is a sectional view of part of ap-
paratus which is provided with means for cool-
ing the clamping members and the sealed
edges of the film.

Referring now to the drawings in detail, the
apparatus comprises a guide or frame 10 in
which the clamping head 12 is slidably mov-
able in any suitable way. As here shown, said
clamping head is moved to the retracted posi-
tion shown by FIG. 1 by tension springs 14
and may be moved downwardly to the project-
ed position illustrated in FIG. 2 in any suitable
way as by a cam or eccentric 16 secured to a
shaft 17 journaled for turning movement in
frame 10 and rotatable in any suitable way
as by a manually or power operated crank or
a lever mechanism (not shown). The clamping
head 12 is provided with two clamping bars
18 and 20 which are disposed in laterally
spaced relation and extend longitudinally in
the direction of the lines at which the superim-
posed layers of film are to be sealed. Each
of said bars is carried by a plurality of sup-
porting members 22 spaced longitudinally of
said bars, as will be readily understood, only
one of said supporting members for each of
said bars being shown. The supporting
member 22 includes a guide member 24 which
is slidable in a companion recess 26 in the
guide head 12 against the force of a compre-
ssive spring 28.

As shown by FIG. 2, upper clamping
members 18 and 20 cooperate with companion
lower clamping members 18a and 20a, respec-
tively, in the manner illustrated by FIG. 2
and evident from a comparison of FIGS. 1
and 2. Said clamping members 18a and 20a
are disposed in laterally spaced relation and
extend longitudinally in confronting relation to
the clamping members 18 and 20, respectively,
as will be readily understood. The lower guide
head 30 for clamping members 18a and 20a
is stationary and comprises the guide recesses
32 which are similar to the guide recesses 26

for the upper clamping members 18 and 20.
The lower clamping members 18a and 20a are
carried by a plurality of longitudinally spaced
supporting rods or studs 34, only one of said
studs for each of said bars 18a and 20a being
shown. The guide members 36 to which the
said studs 34 are secured are movable in the
guide recesses 32 and are spring loaded by
the compression springs 38. It will be readily
understood that the guide head 12 is moved
downwardly into engagement to clamp the su-
perimposed layers 40 of thermoplastic film re-
siliently but firmly between the companion
clamping members 18 and 18a of one pair of
clamping members and between the clamping
members 20 and 20a of the other pair of
clamping members.

As briefly described above, heat is applied
to the adjacent surfaces of both layers of ther-
moplastic film when said layers are clamped
together. For this purpose, upper and lower
metal bands 42 and 44 are mounted in the
apparatus. The radiant heating elements can
be formed of any high resistance alloy and
have a greater width than thickness. The di-
mensions of these radiant elements are not cri-
tical, although a suitable radiant element
would have a width of one eighth of an inch
(1/8") and a thickness of .018 inch. The lower
band 44 may be stationary, while the upper
band is movable with the guide head 12 being
supported thereby for movement toward and
away from the thermoplastic films, as is evi-
dent from an inspection of FIG. 1 in com-
parison with FIG. 2.

The support for the upper radiant heating
element 42 comprises a plurality of longitudi-
nally spaced rods 46 secured to the guide head
12 in the space between the laterally spaced
guide recesses 26. More specifically, radiant
heating element 42 is carried by a bracket 48
which is secured to said rods 46 in any suitable
way. In order to maintain radiant heating ele-
ment 42 taut when it is heated by the passage
of electric current therethrough, one end of
said element is secured to bracket 48 in any
suitable way as by screw 50 and the opposite
end of said radiant heating element is connect-
ed to one end of a tension spring 52, the other
end of which is secured to a pin 54 fixed to
bracket 48. It will be understood that if ra-
diant heating element 42 expands longitudi-
nally when heated, it is maintained taut by spring
52 and thereby prevented from sagging. The
lower heating element 44, which is preferably
stationary, although it could be movable, is po-
sitioned so that its upper surface is slightly
below the adjacent surface of the lower film
layer in the clamping condition of the two film
layers illustrated in FIG. 2. A bracket support
and device for maintaining the radiant element
44 in taut condition is provided, as indicated
at 56, it being understood that said bracket
and means for maintaining element 44 in taut
condition is the same as that shown by FIG.

3, and that a plurality of rods 58 are connected to bracket 56 in longitudinally spaced relation in a manner generally similar to the connection of rods 46 to bracket 48 illustrated in FIG. 3. Bracket 56 is secured to the lower guide head 32 in any suitable way as by one or more cross members 60. It will be understood that the heating elements 42 and 44 are insulated from their metal supports and are each connected at its opposite ends to an electric current source.

The manner of practising the method of the present invention according to FIGS. 1 to 3 is obvious from the above description, especially the brief description followed by the detailed description of the apparatus with reference to the drawings. Therefore, further description of the method or the operation of the apparatus is unnecessary. It is to be noted, however, that the portions of the film assembly which extend laterally beyond the clamps at the sealing line are heated simultaneously and directly at the opposite sides thereof by the radiant heating elements 42 and 44, respectively, as soon as the clamping operation takes place, whereby said portions are subjected to intense heat which rapidly melts said portions with flow to the adjacent sides, respectively, of the pairs of clamps resulting in the formation of sealed beaded edges of the film plies at said sides of the clamps.

In the form of the invention illustrated by FIGS. 4 to 8, provision is made for applying pressure to the sealed beaded edge while said edge is plastic and before the heating member is retracted. The apparatus includes the companion film clamping members 60, 61 and 62, 63 between which surface portions of the superimposed film plies 40 are clamped by operation of the mechanism indicated at 16 against the retractive action of the springs 14 substantially in the same way as described with reference to FIG. 1. In the apparatus of FIGS. 4 to 8, the radiant heating member 64 is in the form of a ribbon or flat wire similar to the ribbon 42 of FIGS. 1 to 4 except that it is preferably positioned, so that its wider face is vertically disposed. The means for applying pressure to the sealed beaded edges 65 to squeeze the sealed edge comprises the additional companion pressing members 66, 67 and 68, 69 which are slidably movable in relation to clamps 60, 61 and 62, 63, respectively, which position and guide said additional pressing members.

The upper pressing members 66 and 68 are moved downwardly by a plate 70 actuated by cams 71 against the retractive force of tension springs 72. A similar cam and spring arrangement 73, 74 is provided for the lower plate 75 which moves the lower pressing members 67 and 69 against the retractive force of tension springs 74 in unison with the movement of the upper pressing members 66 and 68.

The bead squeezing action of the apparatus

of FIGS. 4 to 8 is apparent from FIGS. 7 and 8. FIG. 7 shows the condition of the sealed edges before they are squeezed by companion pressing members 66, 67 and 68, 69. It will be understood that the companion clamping members 60, 61 and 62, 63 are moved from the positions shown in FIG. 4 to film clamping positions and the portion of the film plies between the clamped surface portions of the film is heated by the radiant heater member 64 without contact of said heater with the films. This heating of the film plies results in the severing of the plies along a line extending in the longitudinal direction of the heater member and the heated portions melt and shrink back to near surfaces of the companion clamping members 60, 61 and 62, 63, respectively, as shown by FIG. 7, forming the sealed beaded edges 65. Thereafter the pressing members 66, 67 and 68, 69 are operated to the position illustrated by FIG. 8 to squeeze the beaded edges while they are still plastic and heated by member 64. This squeezing action improves the seal and is especially useful for obtaining good sealing of badly wrinkled plies of film. The squeezed edges are indicated at 65' in FIG. 8.

It will be understood that the apparatus of FIGS. 1 to 3 can be provided with the bead squeezing devices of FIGS. 4 to 8 and heaters shown by FIGS. 1 to 3 can be employed in the apparatus of FIGS. 4 to 8. Other forms of radiant heating members can be used as illustrated, for example but without limitation, by FIGS. 9 to 12. As shown by FIG. 9, two radiant heating members 64a in the form of round wires may be used. As shown by FIG. 10, the radiant heating members 64b can be triangular in cross section. In FIG. 11, the radiant heating member 64c can be of tapering configuration. As shown by FIG. 12, two flat radiant heating members 64d and 64e can be used, heating member 64d being vertically positioned and heating member 64a being horizontally positioned.

FIG. 13 illustrates how the distance of the clamping members 80, 81 and 82, 83 from the radiant heaters indicated at 42a and 44a may be varied. As here shown, the upper and lower frames 84 and 85 are slotted as indicated at 86 and the bars 87 which carry the clamping members are movable in slots 86 toward and away from said heaters and are secured in the desired positions by clamping nuts 88 which engage the threaded outer ends 89 of said bars. Each bar 87 has a flange 90 on which a compression spring 91 bears, said spring being positioned within a sleeve 92 which is engaged internally at its end remote from flange 90 by said spring. As shown by FIG. 13, each film clamping member, which is ordinarily made of metal is provided on its clamping surface with a thin cushioning layer of a material such as silicone rubber or polytetrafluoroethylene.

Referring to FIG. 14, the apparatus may comprise companion stationary and movable clamping members 93, 94 and 95, 96. The movable clamping members 94 and 96 may be operated in the same way as the movable clamping members of FIG. 1. As here shown, the film clamping members have beveled sides 97 instead of vertical sides of the clamping members in the forms of the invention illustrated by FIGS. 1 to 13. A part of the radiant heating member is indicated at 98 and may be the same as the radiant heating member 64 of FIGS. 4 to 8 or any other form of radiant heating devices may be employed, for example but without limitation, the forms shown in FIGS. 1 to 3 and 9 to 13, inclusive. FIG. 14 of the drawings also discloses that the heat sealing apparatus of the present invention may be provided with means for air cooling the film pressing members and the sealed edge or edges of the film plies upon retractive movement of the radiant heating member 98. For this purpose the frame 100 on which the film clamping members 93 and 95 are carried is provided with an air duct 102 leading to air passage 104 which, it will be understood, extends longitudinally of the base 100, said air passage being defined by the inner surface of said base which confronts the U-shaped member 105 which also extends longitudinally of the base. Air duct 102 is connected to a source of air pressure through a solenoid operated valve 106. It will be understood that when the radiant heating member 98 is in position for heating and severing the film plies, valve 106 is closed, and that when the movable clamping members 94 and 96 are retracted together with the heating member 98, the solenoid indicated at 108 is energized for opening the valve 106. The electric circuit of solenoid 108 may be controlled in any suitable way, for example by a microswitch 110 actuated by a member 112 carried by one of the bars on which one of the movable film clamping members is mounted.

A method and apparatus of cutting and sealing superposed thermoplastic plies with the aid of a hot gaseous stream is described and claimed in copending application No. 4556/64 (Serial No. 1058663).

WHAT WE CLAIM IS:—

1. Apparatus for cutting and sealing an assembly of superposed plies of thermoplastic film along a predetermined line, the apparatus comprising a first pair of elongate laterally spaced clamping members and a second pair of elongate laterally spaced clamping members, the first pair being movable to releasably clamp such an assembly against the second pair along both sides of a zone including the said line so as to leave exposed both faces of the clamped assembly within the zone, and a first heating member being mounted between the first pair of clamping members for move-

ment to a position adjacent to the clamped assembly for cutting and sealing the assembly by melting a gap along the said line and fusing together the superposed edges of the plies bounding the gap.

2. Apparatus for cutting and sealing an assembly of superposed plies of thermoplastic film along a predetermined line, the apparatus comprising a first pair of elongate laterally spaced clamping members and a second pair of elongate laterally spaced clamping members, the first pair being movable to releasably clamp such an assembly against the second pair along both sides of a zone including the said line so as to leave exposed both faces of the clamped assembly within the zone, and first and second heating members for cutting and sealing the assembly by melting a gap along the said line and fusing together the superposed edges of the plies bounding the gap, the first heating member being mounted between the first pair of clamping members for movement to a position adjacent to the clamped assembly and the second heating member being mounted between the second pair of clamping members.

3. Apparatus according to claim 1 or 2 wherein the first and second pairs of clamping members are mounted on respective first and second common bases.

4. Apparatus according to claim 3 wherein the first heating member is mounted on the first base.

5. Apparatus according to claims 2, 3 and 4 wherein the second heating member is mounted on the second base.

6. Apparatus according to any of claims 1 to 5 wherein the clamping members of each pair are spring-loaded towards the respective clamping members of the other pair.

7. Apparatus according to claims 5 and 6 wherein the first and second heating members are so fixedly mounted on the respective bases as to be relatively movable towards one another in unison with the respective first and second pairs of spring-biased clamping members until the said pairs of clamping members engage and clamp the assembly therebetween and thereafter further relatively movable towards one another in unison with the respective first and second bases.

8. Apparatus according to any one of claims 1 to 7 including a first pair of pressing members mounted in the space between the first pair of clamping members in register with a second pair of pressing members mounted in the space between the second pair of clamping members, means being provided for moving the opposed pairs of pressing members relatively towards one another for pressing therebetween the fused edges of the plies bounding the gap melted in the assembly.

9. Apparatus according to any one of claims 1 to 8 wherein the lateral spacing between the

first pair of clamping members and between the second pair of clamping members is adjustable.

10. Apparatus according to claim 1 including ducts between the second clamping members for directing coolant gas against the edges of the plies bounding the gap melted in the assembly.

11. Apparatus according to any one of claims 1 to 10 wherein the or each heating member comprises an elongate electrical resistance heating member maintained in taut condition by spring loading.

12. Apparatus for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Figs. 1 to 3 of the accompanying drawings.

13. Apparatus for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Figs. 4 to 12 of the accompanying drawings.

14. Apparatus for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Fig. 13 of the accompanying drawings.

15. Apparatus for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Fig. 14 of the accompanying drawings.

16. A method for cutting and sealing an assembly of superposed plies of thermoplastic film along a predetermined line comprising releasable clamping the plies together along both sides of a zone including the line by means of a first movable pair of elongate laterally spaced clamping members and a second pair of elongate laterally spaced clamping members cooperating therewith so as to leave exposed both faces of the assembly within the zone,

and heating the assembly within the zone by means of a heat source disposed out of contact with the assembly and between the first pair of clamping members to melt a gap therein along the said line and to fuse together the superposed edges of the plies bounding the gap.

17. A method according to claim 16 wherein both faces of the assembly within the zone are heated simultaneously to cut and seal the assembly.

18. A method according to claim 16 or 17 including the additional step of pressing together the fused superposed edges of the plies along each side of the gap whilst the said edges are still plastic.

19. A method according to any of claims 16 to 18 wherein the assembly is resiliently clamped between the pairs of clamping members.

20. A method for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Figs. 1 to 3 of the accompanying drawings.

21. A method for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Figs. 4 to 12 of the accompanying drawings.

22. A method for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Fig. 13 of the accompanying drawings.

23. A method for heat-cutting and sealing an assembly of superposed plies of thermoplastic film substantially as hereinbefore described with reference to Fig. 14 of the accompanying drawings.

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